

The opinion in support of the decision being entered today was **not** written for publication and is **not** binding precedent of the Board.

Paper No. 17

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KEI-YU KO, LI LI,
and GUY T. BLALOCK

Appeal No. 2001-2244
Application No. 09/625,144

ON BRIEF

Before WALTZ, KRATZ, and JEFFREY T. SMITH, *Administrative Patent Judges*.
JEFFREY T. SMITH, *Administrative Patent Judge*.

DECISION ON APPEAL

Applicants appeal the decision of the Primary Examiner finally rejecting claims 1 to 13 and 18 to 27, all of the pending claims in the application. We have jurisdiction under 35 U.S.C. § 134.

BACKGROUND

Appellants' invention relates to a process for selectively etching or patterning a structure that includes doped silicon dioxide. The process is effected with an etchant that comprises $C_2H_xF_y$, where x is an integer from 3 to 5 and y is an integer from 1 to 3, and $x+y=6$. The etchant is formulated to etch doped silicon dioxide at a rate faster than the etch stop. Both undoped silicon dioxide and silicon nitride may be used as an etch stop because such materials are etched at a lower rate than the doped silicon dioxide. (Specification, p.

4). Claims 1 and 8, which are representative of the claimed invention, appear below:

1. A process for selectively etching a structure comprising doped silicon dioxide, the process comprising:

exposing the structure to an etchant comprising $C_2H_xF_y$, where x is an integer from 3 to 5, inclusive,

y is an integer from 1 to 3, inclusive and $x+y=6$; and

removing the structure down to an etch stop adjacent the structure and comprising undoped silicon dioxide, said removing being effected without substantially removing said etch stop.

8. A method for patterning doped silicon dioxide, comprising dry etching at least one exposed region of the doped silicon dioxide with an etchant comprising $C_2H_xF_y$, where x is an integer from 3 to 5, inclusive, y is an integer from 1 to 3, inclusive, where $x+y=6$, said etchant being formulated to etch doped silicon dioxide at a faster rate than undoped silicon dioxide and than silicon nitride.

CITED PRIOR ART

As evidence of unpatentability, the Examiner relies on the following references:

Bosch et al. (Bosch)	5,626,716	May 06, 1997
Ding et al. (Ding)	5,814,563	Sep. 29, 1998

The Examiner rejected claims 1 to 13 and 18 to 27 under 35 U.S.C.
§ 103(a) as obvious over the combination of Bosch and Ding. (Answer, p . 3).

DISCUSSION

We have carefully reviewed the claims, specification and applied prior art, including all of the arguments advanced by both the Examiner and Appellants in support of their respective positions. This review leads us to conclude that the rejection of claims 1 to 13 and 18 to 27 is not well founded. Our reasons appear below.

Bosch discloses a dry etching process that is primarily designed to etch a layer of a doped oxide of silicon, such as a boron-phosphorus doped silicate glass (BPSG) or BPTEOS, not only more readily than the undoped form, but also more readily than silicon nitride. Bosch employs an improved gaseous medium for plasma etching. Specifically, Bosch employs a mixture of CHF₃ (Freon 23) and neon (Ne), preferably in the ratio by volume of about eight parts neon to 1 part Freon 23 as the gaseous medium. (Col. 2, ll. 34 to 44). Bosch discloses that developing plasma etching process is unpredictable.

Specifically, Bosch states “[w]hile elaborate theories have been developed to explain the plasma etching process, in practice most such processes have been developed largely by experimentation involving trial and error because of the relatively poor predictability of results otherwise. Moreover, because of the number of variables involved and because most etching processes depend critically not only on the particular materials to be etched but also on the desired selectivity and anisotropy, such experimentation can be time consuming and success often depends on chance.” (Col. 1, l. 63 to col. 2, l. 5).

Ding discloses a process for etching substrates, and in particular, for etching dielectric layers, such as silicon dioxide, on semiconductor substrates at high etch rates. The process gas comprises (i) fluorohydrocarbon gas capable of forming fluorine-containing etchant species for etching the dielectric layer, (ii) NH_3 -generating gas and (iii) carbon-oxygen gas. (Col. 2, ll. 32-43). According to Ding, the etching process provides unexpectedly high dielectric etch rates up to about 900 nm/minute in combination with excellent etching selectivity ratios. (Col. 2, ll. 52-54). The preferred etchant gas composition comprises (i) fluorohydrocarbon gas selected from the group consisting of CH_3F , CHF_3 , C_2HF_5 , $\text{C}_2\text{H}_2\text{F}_2$, and $\text{C}_2\text{H}_4\text{F}_2$; and (ii) fluorocarbon gas selected from the group consisting of CF_4 , C_2F_6 , C_3F_8 , C_4F_8 and C_4F_{10} . The NH_3 -generating gas can comprise NH_3 ,

NH_4OH , CH_3NH_2 , $\text{C}_2\text{H}_5\text{NH}_2$, $\text{C}_3\text{H}_8\text{NH}_2$. The carbon-oxygen gas can comprise CO , CO_2 , HCOOH , HCOH , CH_3COOH , CH_3OH and mixtures thereof. (Col. 2, l. 62 to col. 3, l. 4).

An inert gas, such as argon, capable of being activated by the plasma to sputter material from the substrate can also be added to the process gas to further enhance etch rates and provide anisotropic etching.

The Examiner asserts, based on the teachings of Bosch and Ding, that CHF_3 and $\text{C}_2\text{H}_4\text{F}_2$ are equivalent and contain similar etching characteristics. Thus, the Examiner concludes the performance of the process of Bosch using a fluorohydrocarbon gas comprising $\text{C}_2\text{H}_4\text{F}_2$ as taught by Ding would have been obvious to a person of ordinary skill in the art. (Answer, p. 4).

We do not agree. The combination of Bosch and Ding does not render the subject matter of independent claims 1, 8, 18, 19 and 22 obvious. As stated above, Bosch discloses that developing plasma etching process is unpredictable. Both Bosch and Ding describe specific plasma etching systems that do not contain similar components. While we recognize that Ding equates CHF_3 and $\text{C}_2\text{H}_4\text{F}_2$, this does not indicate that they are also equivalent in the Bosch process. The Examiner has not directed us to evidence which indicates that the use of $\text{C}_2\text{H}_4\text{F}_2$ in the process of Bosch would provide the etching of doped

silicon oxide more readily than the undoped silicon oxide and silicon nitride as required by Bosch.

The mere fact that the prior art could be modified would not have made the modification obvious unless the prior art suggested the desirability of the modification.

In re Gordon, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984); *In re Laskowski*, 871 F.2d 115, 117, 10 USPQ2d 1397, 1398 (Fed. Cir. 1989). The record indicates that the motivation relied upon by the Examiner for the use of C₂H₄F₂ in the process of Bosch comes from the Appellants' description of their invention in the specification rather than coming from the applied prior art and that, therefore, the Examiner used impermissible hindsight in rejecting the claims. *See W.L. Gore & Associates v. Garlock, Inc.*, 721 F.2d 1540, 1553, 220 USPQ 303, 312-13 (Fed. Cir. 1983); *In re Rothermel*, 276 F.2d 393, 396, 125 USPQ 328, 331 (CCPA 1960). Accordingly, we reverse the Examiner's rejection under 35 U.S.C. § 103(a) of claims 1 to 13 and 18 to 27 over the combination of Bosch and Ding.

Appeal No. 2001-2244
Application No. 09/625,144

REVERSED

THOMAS A. WALTZ
Administrative Patent Judge

PETER F. KRATZ
Administrative Patent Judge

JEFFREY T. SMITH
Administrative Patent Judge

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